REMARKS/ARGUMENTS

Reconsideration of this application in light of the above amendments and following comments is courteously solicited.

Independent claims 20 and 38 have been amended so as to set forth with specificity that the alloy of the present invention is characterized by a uniform homogeneous distribution of fine, submicron Al_3Zr precipitates producing an isotropic grain structure. Support for the claim amendments can be found in the instant application, for example, in paragraph [0022] of the substitute specification filed with the instant application. It is respectfully submitted that the sum total teachings of Japanese Patent Application 05-070910 fails to teach, disclose, suggest or render obvious the aluminum alloy composition and structure as now set forth in the claims as pending.

For the Examiner's convenience, Applicants attach hereto an English translation of the Japanese document 05-070910.

With reference to the Japanese text, after thorough review of the Japanese reference, it is clear that the alloy disclosed therein (hereinafter called JP alloy) has a different structure than the alloy according to the present invention even though the claimed ranges for the main alloying elements Zn and Mg (4.6-5.2% Zn; 2.6-2.8% Mg) are encompassed by the ranges 3-8% Zn and 0.5-3% Mg of the prior art JP alloy.

The Japanese reference is related to a process for producing an AlZnMg based alloy soft material for welded structures. The alloy remains soft when stored at room temperature for a long period, i.e. the alloy does not undergo age hardening at room temperature and therefore maintains its excellent cold workability until it is used.

At the time when the alloy is used requiring strength for a welded structure, the softened material is subjected to T6

treatment, i.e. the soft material is solution heat treated, water quenched and age hardened. An example is given as follows: hold the alloy at 460°C for one hour, thereafter cool with water and temper at 120°C for 24 hours, see page 5, last four lines from the bottom.

The soft material properties are reached with a special heat treatment (called softening treatment) after hot working, when the alloy is held at a temperature of 180 to 320°C for 0.5 to 24 hours as a softening treatment and thereafter cooled to room temperature. By setting the softening treatment after hot working at the above-described ranges, an alloy component consisting of Mg and Zn is precipitated thereby reducing the amount of solid solution in the aluminum phase. Due to the depletion of the aluminum matrix in Zn and Mg, age hardening at room temperature is inhibited.

This softening treatment followed later by age hardening may actually work within the limits given in the Japanese reference for the age hardening elements Zn and Mg as follows, see page 3, [0006]:

> Zn: To increase strength at room temperature. With amounts of less than 3%, high strength cannot be obtained in T4 or T6 material and with amounts of more than 8%, stress corrosion cracking is easily caused.
>
> Mg: To increase strength at room temperature. With amounts of less than 0.5%, high strength cannot be obtained in a T4 or T6 material and with amounts of 3%, stress corrosion cracking is easily caused.

In the Japanese reference,

- an alloy having a tensile strength of not more than 250 MPa and an elongation of not less than 20% as mechanical properties immediately after softening treatment is judged as an accepted product as the criterion for cold workability,
- an alloy having increased in tensile strength by not more than 15 MPa after 90 days storage at room temperature compared to the tensile strength immediately after softening is judged as an accepted product, and
- an alloy having a tensile strength of not less than 350 MPa in a T6 condition, when the softened material was held at 460°C for one hour, therafter cooled with water and tempered at 120°C for 24 hours, is judged as an accepted product.

Parameters within these limits are reached with alloy compositions given in Table 1, i.e. with ranges for Zn and Mg outside the ranges of the alloy according to the present invention.

The problem of quench sensitivity is not addressed in the Japanese reference, because the alloy is water quenched after solution heat treatment at 460°C and thereafter immediately age hardened to reach T6 temper.

The alloy of the present invention is mainly used in the form of plates with a thickness often greater than 150 mm, in some cases even greater than 500 mm to manufacture large molds for injection molding purposes.

One significant disadvantage of the aluminum alloys employed today for mold manufacture is their high quench sensitivity. In order that the ingots or plates reach the necessary strength level for plastic injection molding molds by means of artificial age hardening, the rate of cooling from the homogenization or solution treatment temperature has to be increased with increasing plate

thickness. Due to the resultant high temperature gradients between the surface and the core of the ingot or plate, the magnitude of the undesirable internal stresses increases, so that also for this reason there are limits to increasing the cooling rate further and with that the strength level that can be reached.

In the alloy of the present invention, the composition of the alloy is selected such that it exhibits very low quench sensitivity and in spite of that has an extremely high strength level. Thick cross-sections can therefore be brought to a high strength level by means of forced air cooling and precipitation hardening.

For the alloy according to the invention to be employed as a material for mold manufacture it is necessary to strive for the most isotropic distribution of internal stresses in the cross-section of the plate. By the addition of zirconium it is possible to achieve a fine grain structure in the plate by selecting the rate of heating the ingot to a homogenization or solution treatment temperature such that as the distribution of submicron precipitates of Al_3Zr in the structure is as homogeneous as possible.

During a low heating rate on heating the ingot to the homogenization temperature, the phase boundary interfaces of the precipitated particles of T-phase form preferred nucleant for the Al_3Zr particles which start to precipitate out at around 350°C. On heating the ingot further to the homogenization temperature the previously precipitated T-phase particles dissolve leaving behind a uniform distribution of the fine, submicron Al_3Zr precipitates, which lie on the original particle interfaces of the T-phase and on the subgrain boundaries, thus resulting in a homogeneous distribution. These fine Al_3Zr particles effect a strong resistance to grain growth on recrystallization of the plate both

during solution treatment and during homogenization treatment of the cast ingot, producing the desired isotropic grain structure in the ingot. The grain refining additive Zr is therefore utilized in an optimal manner.

Contrast to the softening treatment used with the JP alloy, the alloy of the present invention is cooled to room temperature by forced air cooling or in a water-air-spray mist. Age hardening takes place directly after ageing at room temperature without a solution heat treatment.

To sum up, the concentrations of Zn and Mg have to be within narrow ranges in the present invention, and Zr must be uniformly distributed as submicron Al_3Zr precipitates, in order to reach the desired properties.

In light of the foregoing, it is respectfully submitted that all of the claims as pending patentably define over Japanese Patent document 05-070910 and the early issuance of a notice of allowance is respectfully requested.

An earnest and thorough attempt has been made by the undersigned to resolve the outstanding issues in this case and place same in condition for allowance. If the Examiner has any questions or feels that a telephone or personal interview would be helpful in resolving any outstanding issues which remain in this application after consideration of this amendment, the Examiner is courteously invited to telephone the undersigned and the same would be gratefully appreciated.

It is submitted that the claims as amended herein patentably define over the art relied on by the Examiner and early allowance of same is courteously solicited.

If any fees are required in connection with this case, it is respectfully requested that they be charged to Deposit Account No. 02-0184.

Respectfully submitted,

By /Gregory P. LaPointe #28395/
Gregory P. LaPointe
Attorney for Applicants
Reg. No.: 28,395

Telephone: 203-777-6628
Telefax: 203-865-0297

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